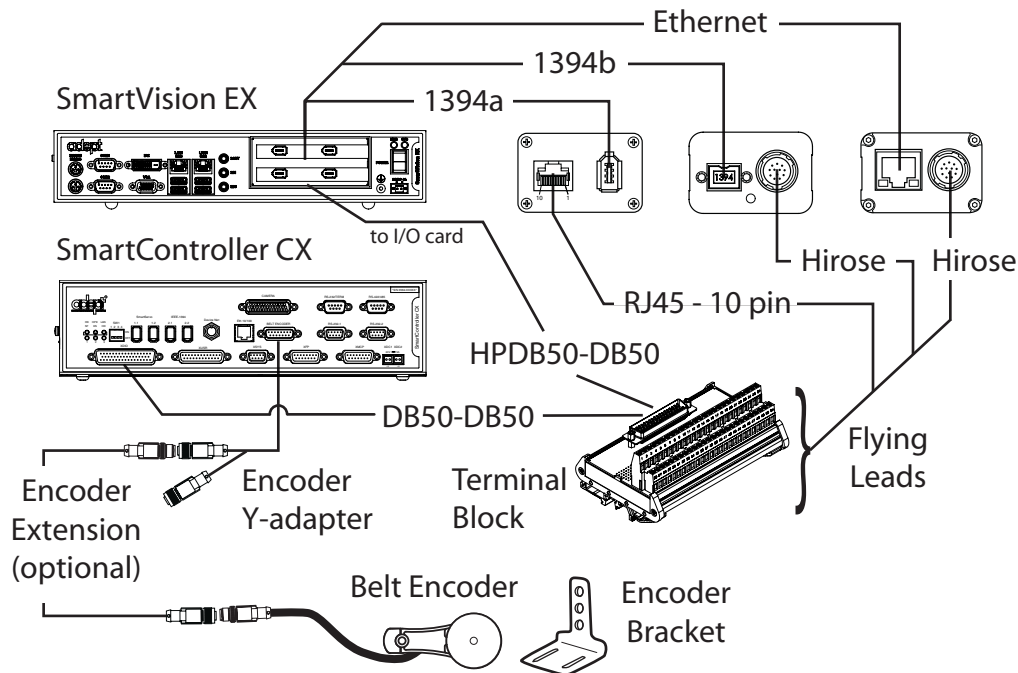


Adept Peripherals

Connection Guide

Common connections to SmartController CX and SmartVision EX



P/N: 09672-000, Rev. A
January, 2010



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Printed in the United States of America

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1.1 Overview

Adept offers a variety of peripherals and cables to make the process of installing a robot system easier.

This manual addresses the tasks of:

- Adding an encoder
- Adding a camera
- Connecting digital I/O to a SmartVision EX

The Adept Peripherals Connections fold-out sheet (P/N: 09672-010) shows connections for adding an encoder, three different types of Basler cameras, and for using an I/O card in the SmartVision EX. This manual provides additional information, such as pin-outs and limitations.

NOTE: Both this manual and the fold-out sheet assume that you will be using the optional terminal block and corresponding DB50 cables.

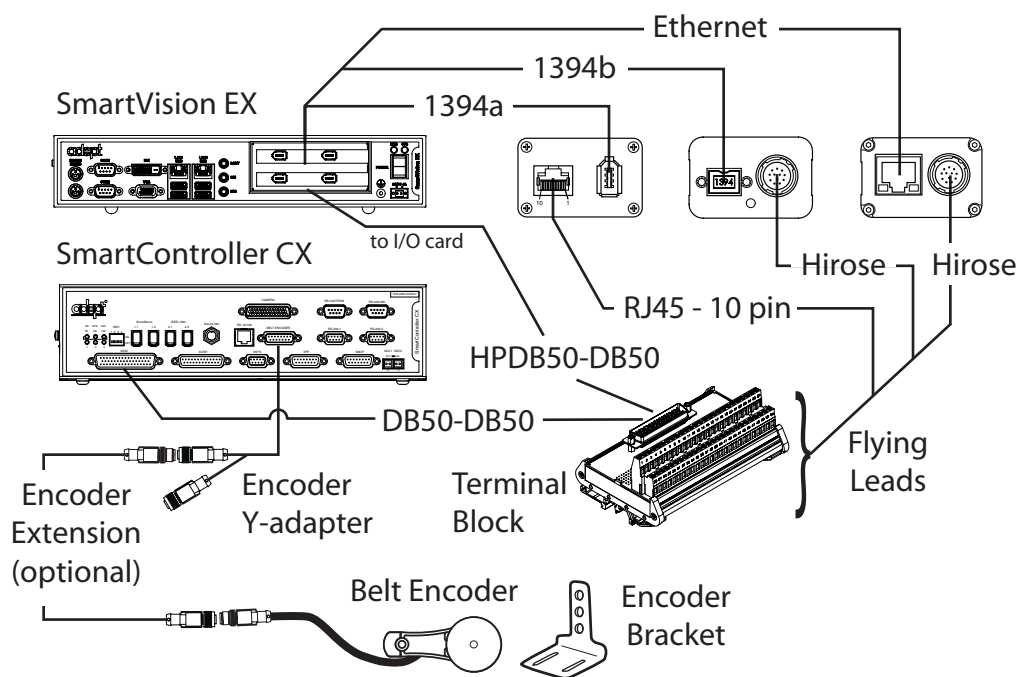


Figure 1-1. Overview of Peripheral Connections

Camera Connection Components

Off-the-shelf cables and connectors that are readily available, such as Ethernet and IEEE 1394 cables, are not listed.

Basler 1394a Camera

Components:	SmartVision EX		
	Basler 1394a Camera		
	10-pin RJ45 cable	10 m	09449-100
Options:	DB50 terminal block		09438-000
	DB50M-DB50F cable	2 m	09447-020
	DB50M-DB50F cable	5 m	09447-050

Basler 1394b Camera and Basler GigE Camera

Components:	SmartVision EX		
	Basler Camera		
	12-pin Hirose cable	10 m	09450-100
Options:	DB50 terminal block		09438-000
	DB50M-DB50F cable	2 m	09447-020
	DB50M-DB50F cable	5 m	09447-050

Encoder Connection Components

Components:	SmartController CX		
	TR-1 Encoder (with wheel)	0.5 m	09439-000
	Encoder mounting bracket		09439-100
	Encoder cable (Y-adapter)	3 m	09443-000
Options:	Encoder extension cable	5 m	09446-050

I/O Card Connection Components

Components:	SmartVision EX		
	PCIe I/O card		09228-040
	HPDB50-DB50 cable	2 m	09448-020
Options:	DB50 terminal block		09438-000
	DB50M-DB50F cable	5 m	09447-050

1.2 Document Layout

- This manual supplements the two-sided, 11 x 17 in. fold-out Adept Peripherals Connections sheet, P/N 09672-010.
- **Chapter 2** of this manual consists of the same content as the Adept Peripherals Connections sheet, in standard Adept manual format.
- **Chapter 3** provides details to support Chapter 2.
- **Chapter 4** provides pinouts for cables and ports used for connecting Adept peripherals.

1.3 Safety

The installation and use of Adept products must comply with all safety instructions and warnings in their respective manuals. Installation and use must also comply with all applicable local and national requirements and safety standards.

We recommend that you read the *American National Standard for Industrial Robot Systems - Safety Requirements*, published by the Robotic Industries Association (RIA) in conjunction with the American National Standards Institute. The publication, ANSI/RIA R15.06, contains guidelines for robot system installation, safeguarding, maintenance, testing, startup, and operator training.

We also recommend that you read the International Standard IEC 204 or the European Standard EN 60204, *Safety of Machinery – Electrical Equipment of Machines*, and ISO 10218 (EN 775), *Manipulating Industrial Robots – Safety*, particularly if the country of use requires a CE-certified installation.

This manual assumes that the user has attended an Adept training course and has a basic working knowledge of Adept systems. The user should provide the necessary additional training for all personnel who will be working with Adept systems.

1.4 How to Get Help

For details on getting assistance with your Adept software or hardware, you can access the following information sources on the Adept corporate website:

- For Contact information: <http://www.adept.com/contact/americas>
- For Product Support information: <http://www.adept.com/support/service-and-support/main>
- For further information about Adept Technology, Inc.: <http://www.adept.com>

1.5 Related Manuals

This manual covers the connection of Adept Peripherals. There are additional manuals that cover installation and use of the Adept SmartController and Adept SmartVision EX. The following manuals (available on the Adept Document Library CD-ROM provided with each system) provide information on advanced configuration and system specifications.

Table 1-1. Related Manuals

Manual Title	Description
<i>Adept SmartVision EX User's Guide</i>	Details the installation, configuration, and use of your Adept SmartVision EX. The Adept SmartVision EX must be set up and configured before using some of the peripherals.
<i>Adept SmartController User's Guide</i>	Details the installation, configuration, and use of your Adept SmartController CX. The Adept SmartController CX must be set up and configured before control programs will execute properly.

1.6 Adept Document Library

The Adept Document Library (ADL) contains documentation for Adept products. You can access the ADL either from the CD-ROM provided with each system, or on-line as follows:

- Select **Support > Document Library** from the menu bar on the Adept website Home page, or
- Type the following URL into your web browser:

http://www.adept.com/Main/KE/DATA/adept_search.htm

To locate information on a specific topic, use the Document Library search engine on the ADL Search page. To view a list of available document titles, select an option from one of the listed product categories.

Connections

This section repeats the contents of the 11 x 17 in. fold-out sheet, P/N: 09672-010.

2.1 Connecting an Encoder

Components Used:

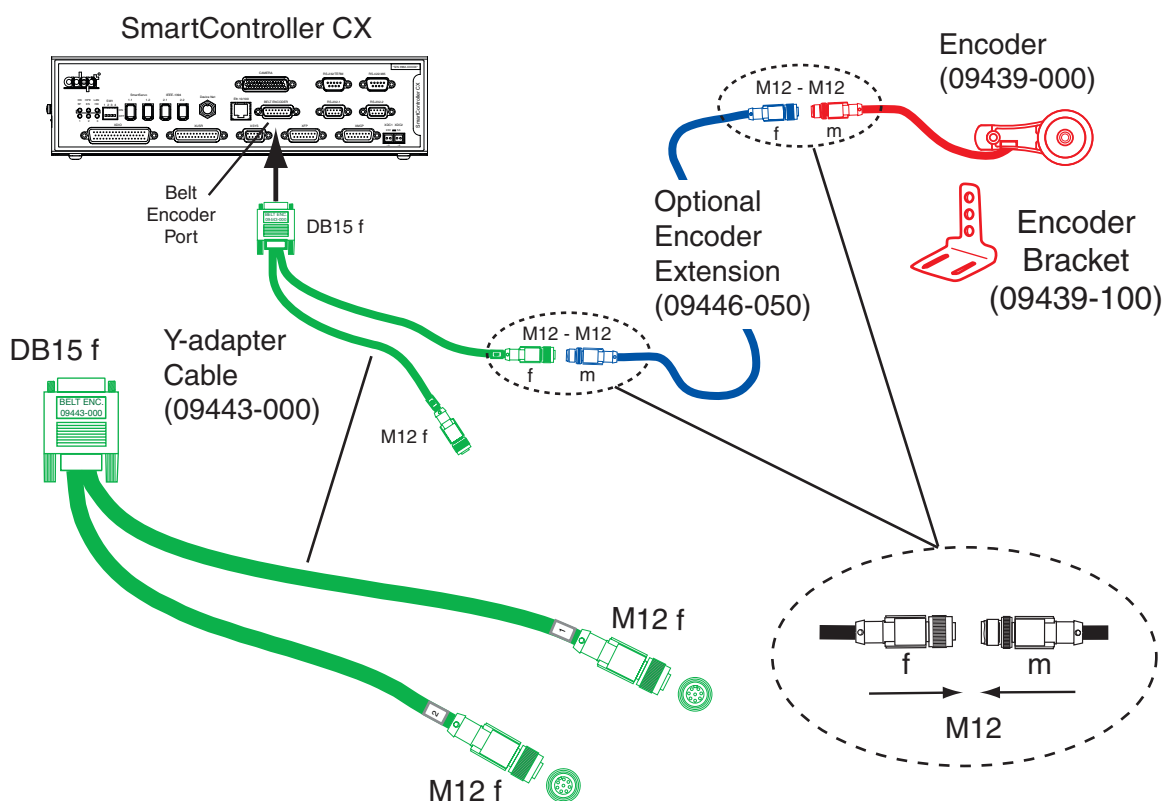
- Belt Encoder (0.5 meter cable)
- Belt Encoder Mounting Bracket
- Belt Encoder Cable with Y-Adapter, DB15 to M12 Female, 3 meter

Option:

- M12 Extension Cable (M - F), 5 meter

Connects to:

- Adept SmartController CX



1. Mount the encoder and encoder mounting bracket.
2. Connect the encoder cable to the Y-adapter (an encoder extension cable may be used).
3. Plug the Y-Adapter cable into the Belt Encoder port of the SmartController.

2.2 Connecting a Basler 1394a Camera

Components Used:

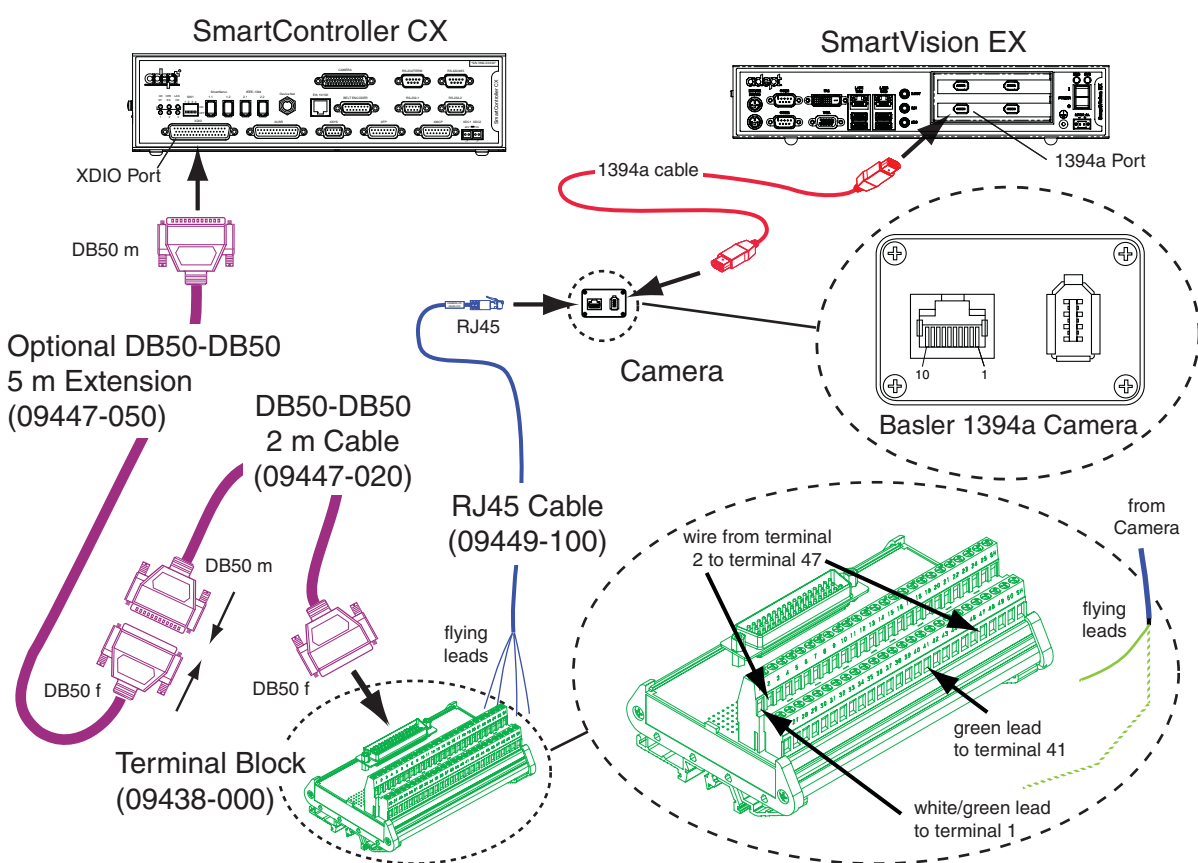
- Basler 1394a camera
- 1394a cable
- RJ45 10-pin - unterminated cable, 10 meter

Connects to:

- Adept SmartController CX
- Adept SmartVision EX (1394a PCIe board)

Options:

- DB50 - DB50 Extension Cable (M - F), 5 meter
- Terminal Block
 - 16- 20 AWG wire, 0.3 meter
 - DB50 - DB50 Cable (M - F), 2 meter



1. Connect the 1394a cable from the camera to the 1394a port on the SmartVision EX.
2. Connect the 10-pin RJ45 cable from the camera to the terminal block.
 - a. Connect the RJ45 green wire to terminal 41 on the terminal block.
 - b. Connect the RJ45 white/green wire to terminal 1 (signal 1001) on the terminal block.
3. Connect the terminal block DB50 to the SmartController XDIO port.
4. Connect terminal 2 (signal 1001) to terminal 47 on the terminal block with light gauge wire (16 - 20 AWG).

2.3 Connecting a Basler 1394b Camera

Components Used:

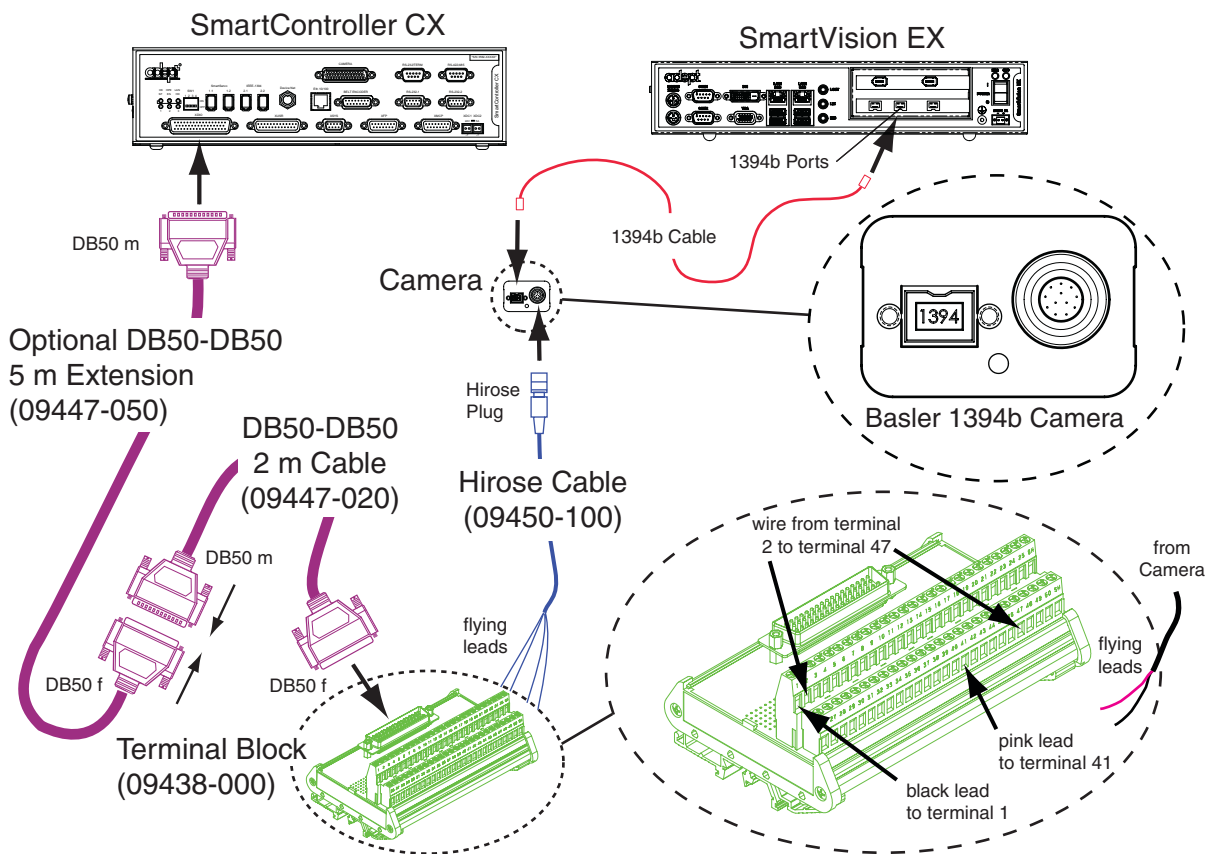
- Basler 1394b camera
- 1394b cable
- Hirose - unterminated cable, 10 meter

Connects to:

- Adept SmartController CX
- Adept SmartVision EX (1394b PCIe board)

Options:

- DB50 - DB50 Extension Cable (M - F), 5 meter
- Terminal Block
 - 16 - 20 AWG wire, 0.3 meter
 - DB50 - DB50 Cable (M - F), 2 meter



1. Connect the 1394b cable from the camera to the 1394b port on the SmartVision EX.
2. Connect the 12-pin Hirose cable from the camera to the terminal block.
 - a. Connect the Hirose pink wire to terminal 41 on the terminal block.
 - b. Connect the Hirose black wire to terminal 1 (signal 1001) on the terminal block.
3. Connect the terminal block DB50 to the SmartController XDIO port.
4. Connect terminal 2 (signal 1001) to terminal 47 on the terminal block with light gauge wire (16 - 20 AWG).

2.4 Connecting a Basler GigE Camera

Components Used:

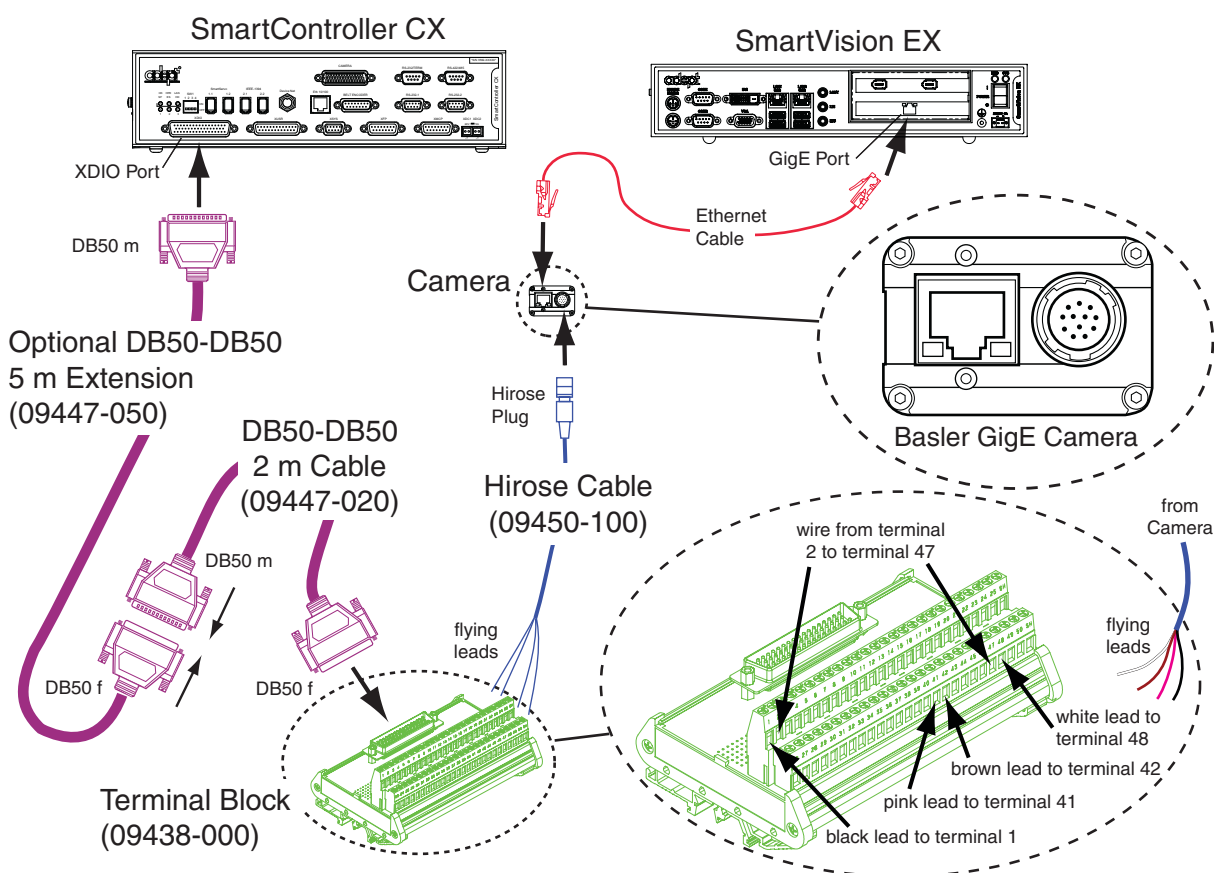
- Basler GigE camera
- Ethernet cable
- Hirose - unterminated cable, 10 meter

Connects to:

- Adept SmartController CX
- Adept SmartVision EX (GigE PCIe board)

Options:

- DB50 - DB50 Extension Cable (M - F), 5 m
- Terminal Block
 - 16 - 20 AWG wire, 0.3 meter
 - DB50 - DB50 Cable (M - F), 2 meter



1. Connect the Ethernet cable from the camera to the GigE port on the SmartVision EX.
2. Connect the 12-pin Hirose cable from the camera to the terminal block.
 - a. Connect the Hirose pink wire to terminal 41 on the terminal block.
 - b. Connect the Hirose black wire to terminal 1 (signal 1001) on the terminal block.
 - c. Connect the Hirose brown wire to terminal 42 on the terminal block.
 - d. Connect the Hirose white wire to terminal 48 on the terminal block.
3. Connect the terminal block DB50 to the SmartController XDIO port.
4. Connect terminal 2 (signal 1001) to terminal 47 on the terminal block with light gauge wire (16 - 20 AWG).

2.5 Connecting Digital I/O

Components Used:

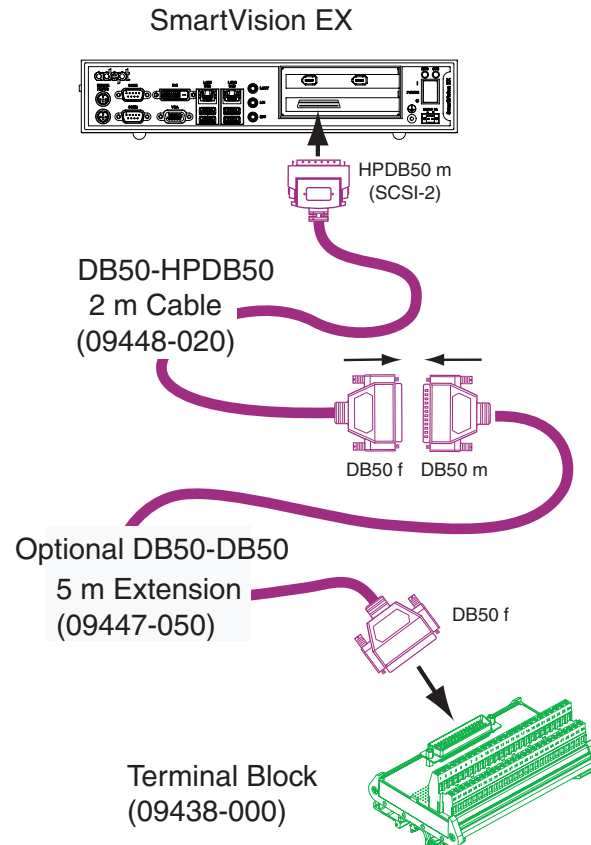
- DB50 - HPDB50 Cable, 2 meter (supplied with the I/O board)

Connects to:

- Adept SmartVision EX (I/O PCIe board)

Options:

- Terminal Block
- DB50 - DB50 Extension Cable (M - F), 5 meter



1. Connect the HPDB50 end of the 2-meter cable to the I/O card on the SmartVision EX.
2. Connect the DB50 end of the 2-meter cable to the terminal block.

Peripheral Connection Details

3

The fold-out sheet assumes the simplest installation for the items covered: one encoder only, use of the first available signal for connections to the terminal block, etc.

This section elaborates a bit, to cover the next level of complexity that you might encounter if your installation is a bit more complicated.

3.1 Encoders

Y-Adapter Cable

The Y-Adapter Cable can connect to two encoders.

One SmartController CX can process two belt encoders through the Belt Encoder jack.

Encoder Extension Cable

If you need to connect more than two encoder extension cables, contact Adept.

3.2 Cameras

Breakout Terminal Block

Although the terminal block is optional, the fold-out and this manual assume you will be using one, along with its corresponding DB50 cables.

NOTE: For individual terminal connections, 16 - 20 AWG wire is recommended.

NOTE: Pin numbers on the terminal block match those on the XDIO port on the SmartController and the PCIe I/O card on the SmartVision EX.

The terminal block is used to connect pins on the SmartController XDIO port and the SmartVision EX I/O card to user data and power lines. Some Adept-supplied cables, such as the Hirose and RJ45, have flying leads that connect to individual terminals on the terminal block.

All user connections are made with flying leads attached to individual terminals. See [Table 4-3, "XDIO Digital I/O Connector Pin Assignments," on page 19](#) and [Table 4-4, "I/O Card Pin Assignments," on page 20](#) for pinout information.

SmartController CX Connections

The terminals you use on the terminal block will determine where the SmartController will find the corresponding signals. For cameras, these are latch or strobe signals. These are covered in the next section.

The Input Return for the Input Signal you use needs to be wired back to Ground on the terminal block. If, for instance, you used Input Signal 1001, then you need to wire Input Return 1001 to Ground. 16 - 20 AWG wire is recommended.

SmartController CX Latch Configuration

In addition to the physical wiring, the SmartController's configuration must be set to read the latch input signal.

This can be done from CONFIG_C or an Adept ACE-based utility program.

Edit the configuration file, and, in the ROBOT section, add the following line:

```
BELT 1 = "/POS_LATCH 1001"
```

This means that, when signal 1001 (Pins 1 and 2 on the XDIO connection) goes HIGH, the encoder value of Belt Index 1 will be latched. If you wired one of the other signals, replace 1001 with the appropriate signal number.

NOTE: The drawings in the fold-out use signal 1001. You can choose other signals, and change the wiring and configuration, as needed. Refer to [Table 4-3, "XDIO Digital I/O Connector Pin Assignments," on page 19](#) for other signal connections.

This format is supported on the CX controller. There should be no other references to "POS_LATCH xxxx" in any of the other config file sections.

NOTE: Do not use "POS_LATCH1". This is for legacy systems, and is not supported on the SmartController CX.

Camera Speed (throughput)

GigE

A standalone SmartVision EX (not connected to a SmartController or network) can have up to four Ethernet ports: two are built-in, and two more are possible with two GigE expansion cards. The SmartVision EX unit makes no distinction between the different Ethernet ports. Four ports will support up to four cameras at the full GigE speed of 1000 Mbit/s each.

A SmartVision EX that is connected to a SmartController or network will have one built-in Ethernet port available, and one more for each GigE expansion card in the unit.

If a switch is used to add more cameras, the 1000 Mbit/s will be shared between all cameras being serviced by each port. Two cameras on one port can run at a maximum speed of 500 Mbit/s each, and so on.

1394b

Each 1394b expansion card has three ports. The total capacity of each card is 800 Mbit/s, which is divided between the number of cameras using that card. The fastest throughput per camera is obtained with one camera per card, yielding the full 800 Mbit/s for that camera. Two cameras on one card can operate at 400 Mbit/s each, and so on.

Adding a second 1394b card adds another 800 Mbit/s of bandwidth, which will be divided between the cameras connected to that card.

1394a

Each 1394a expansion card has two ports. The total capacity of each card is 400 Mbit/s, which is divided between the number of cameras using that card. The fastest throughput is obtained with one camera per card, yielding the full 400 Mbit/s for that camera. Two cameras on one card can operate at a maximum speed of 200 Mbit/s each.

Adding a second 1394a card adds another 400 Mbit/s of bandwidth, which will be divided between the cameras connected to that card.

Basler 1394a Camera

RJ45 cable pin assignments are listed in [Table 4-2, “RJ45 Cable Pin Assignments,” on page 18](#).

Wire colors for non-Adept RJ45 cables may not match Adept cables.

NOTE: The RJ45 will not be needed for a 1394a camera if a conveyor is not used, and the camera latch and strobe signals are not used.

NOTE: The RJ45 connector on the back of the Basler 1394a camera looks similar to an Ethernet connector, but the RJ45 has 10 pins. A standard Ethernet connector will not work for connecting to a Basler 1394a camera.

Basler 1394b Camera

The Hirose cable provides signal lines for latch and strobe. Hirose cable pin assignments are listed in [Table 4-1, “Hirose Cable Pin Assignments,” on page 17](#).

NOTE: The Hirose cable will not be needed for a 1394b camera if a conveyor is not used, and the camera latch and strobe signals are not used.

Basler GigE Camera

NOTE: A GigE camera can be connected to any available Ethernet port on the SmartVision EX.

24 VDC power, which is normally supplied to a GigE camera through the Hirose cable, can instead be supplied by a suitable external power supply. The *Adept SmartController User's Guide* and *Adept SmartVision EX User's Guide* give guidelines and sources for suitable power supplies.

The Hirose power pins can only reliably supply about 700 mA, so the configuration shown in the fold-out would work for one or two GigE cameras (Basler specs the cameras at ~250 mA @ 24 V), assuming that no other I/O is using some of this power. If more cameras are used, or additional I/O power is used for other purposes, then an external power supply will be needed.

3.3 SmartVision EX I/O Card

This manual is written assuming you will use a terminal block with the SmartVision EX I/O card.

It is also possible to use an HPDB50 cable with flying leads to access the I/O card, but Adept recommends use of a terminal block for these connections.

Pinouts 4

This chapter shows pinouts for cables and ports used for connecting Adept peripherals.

4.1 Hirose 12-pin Cable

The Hirose cable is used to provide power for Basler GigE cameras, and to carry latch and strobe signals for Basler GigE and 1394b cameras.

Table 4-1. Hirose Cable Pin Assignments

Pin	Color	Signal	Pin	Color	Signal
1	White	Camera Power GND ^a	7	Violet	I/O Output 2
2	Green	Camera Power GND	8	Brown	Camera Power VCC ^b
3	Blue	I/O Input 1	9	Yellow	Camera Power VCC
4	Red	I/O Input 2	10	Pink	IO Output VCC
5	Gray	I/O Input GND	11	Gray/Pink	I/O Output 3
6	Black	I/O Output 1	12	Red/Blue	I/O Output 4

^a Pins 1 and 2 are tied together inside the camera.

^b Pins 8 and 9 are tied together inside the camera.

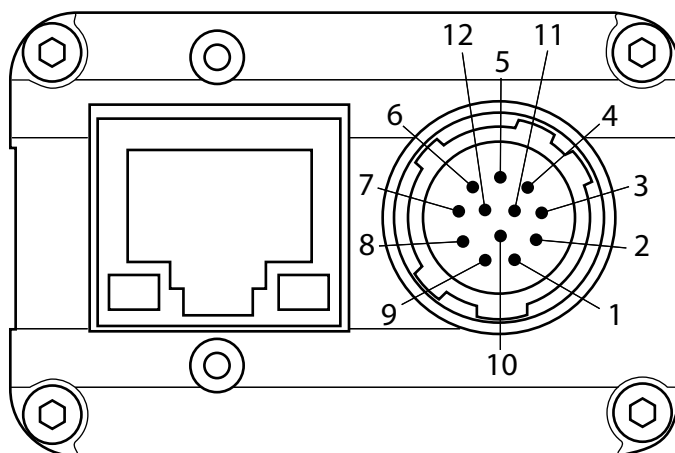


Figure 4-1. Back of Basler GigE Camera, with Hirose Pin Numbers

4.2 RJ45 10-pin Cable

The Basler 1394a camera uses an RJ45 10-pin cable to carry latch and strobe signals.

NOTE: The wire colors in the following table are for the Adept RJ45 cable only. RJ45 cables purchased from other sources may have different wire colors.

Table 4-2. RJ45 Cable Pin Assignments

Pin	Wire Color	Signal	Pin	Wire Color	Signal
1	White/Grey	Output Port 3 -	6	White/Blue	In Gnd Comm
2	White/Orange	Output Port 2 -	7	Green	Out VCC Comm
3	Orange	Output Port 1 - (TrigRdy)	8	White/Brown	Input Port 2 +
4	White/Green	Output Port 0 - (IntEn)	9	Brown	Input Port 1 +
5	Blue	Input Port 0 +	10	Grey	Input Port 3 +

By default, Output Port 0 transmits a signal indicating when exposure has taken place.

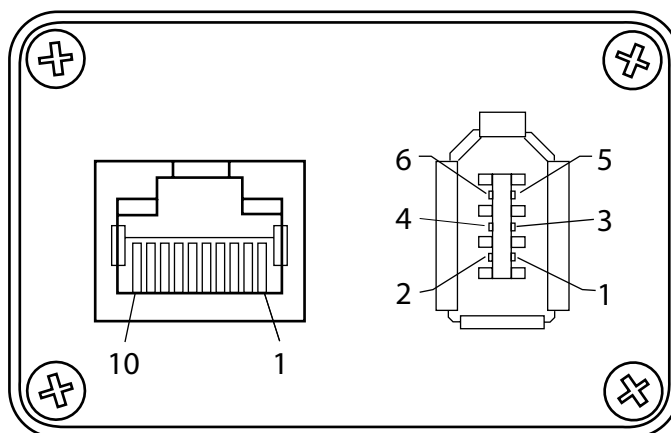


Figure 4-2. Back of Basler 1394a Camera, with Pinouts

4.3 XDIO Connector

The XDIO connector on the SmartController is a 50-pin, standard-density D-Sub female connector. There are 12 inputs and 8 outputs, each optically isolated from the circuitry of the SmartController. The signals are numbered 1001 through 1012 for the inputs and 1 through 8 for the outputs. Each channel has an input and a corresponding return line.

All the signals have independent source and ground connections. These inputs contain the four high-speed inputs that are used by the system for interrupts and latching. The outputs, although independent, have a lower current rating of 100 mA compared to 700 mA for the extended outputs on the sDIO. See the [V+ Language User's Guide](#) for information on digital I/O programming.

The connector also provides 24 V pins for powering customer equipment. There are four 24 V pins and four ground pins, which are limited to a total of 1 A of current. The source of the 24 V is the XDC connector on the front of the SmartController.

Table 4-3. XDIO Digital I/O Connector Pin Assignments

Pin	Signal	Pin	Signal
1	Input 1001	2	1001 return
3	Input 1002	4	1002 return
5	Input 1003	6	1003 return
7	Input 1004	8	1004 return
9	Input 1005	10	1005 return
11	Input 1006	12	1006 return
13	Input 1007	14	1007 return
15	Input 1008	16	1008 return
17	Input 1009	18	1009 return
19	Input 1010	20	1010 return
21	Input 1011	22	1011 return
23	Input 1012	24	1012 return
25	Output 0001+	26	Output 0001–
27	Output 0002+	28	Output 0002–
29	Output 0003+	30	Output 0003–
31	Output 0004+	32	Output 0004–
33	Output 0005+	34	Output 0005–
35	Output 0006+	36	Output 0006–
37	Output 0007+	38	Output 0007–
39	Output 0008+	40	Output 0008–
41	24 V Output ^a	42	24 V Output ^a
43	24 V Output ^a	44	24 V Output ^a
45	V ⁺ High Power On Indicator +	46	V ⁺ High Power On Indicator –
47	24 V return	48	24 V return
49	24 V return	50	24 V return

^a Limited to combined total of 1 A of current.

4.4 PCIe I/O Card Connections

The I/O card on the SmartVision EX has a single port: a 50-pin, half-pitch D-Sub female (HPDB50). There are 16 inputs and 16 outputs. The signals are numbered 1001 through 1016 for the inputs and 1 through 16 for the outputs.

Table 4-4. I/O Card Pin Assignments

Pin	Signal	Pin	Signal
1	VDD Input (fly-wheel diode)	26	VDD Input (fly-wheel diode)
2-4	Common ground or common power for inputs 1009 - 1016	27	Isolated power output 5 V (Do not use)
		28-29	Common ground or common power for inputs 1009 - 1016
5	Output 8	30	Output 15
6	Output 7	31	Output 16
7	Output 6	32	Output 13
8	Output 5	33	Output 14
9	Output 4	34	Output 11
10	Output 3	35	Output 12
11	Output 2	36	Output 9
12	Output 1	37	Output 10
13	Input 1004 High	38	Input 1008 High
14	Input 1004 Low	39	Input 1008 Low
15	Input 1003 High	40	Input 1007 High
16	Input 1003 Low	41	Input 1007 Low
17	Input 1002 High	42	Input 1006 High
18	Input 1002 Low	43	Input 1006 Low
19	Input 1001 High	44	Input 1005 High
20	Input 1001 Low	45	Input 1005 Low
21	Input 1012	46	Input 1016
22	Input 1011	47	Input 1015
23	Input 1010	48	Input 1014
24	Input 1009	49	Input 1013
25	Output Gnd	50	Output Gnd

Optional I/O Products

These optional products are also available for use with digital I/O:

- **Terminal Block**, with terminals for user wiring. Connects to the PCIe connector on the I/O card in the SmartVision EX or the XDIO port on the SmartController CX. (09438-000)

This manual and the corresponding fold-out sheet assume you will be using a terminal block.

NOTE: The I/O card is supplied with an HPDB50 - DB50 Cable (09448-020), 2 meters long, for connecting the I/O card to the terminal block.

- **DB50 - DB50 Extension Cable**, 5 meters long. (09447-050)

Input Signals

The 16 inputs are arranged in two groups. Inputs 1001 through 1008 are independently isolated and differential. Inputs 1009 through 1016 are grouped into a bank, and all share a single common source/sink line.

The inputs are accessed through direct connection to the 50-pin connector (see [Table 4-4 on page 20](#)), or through the optional terminal block.

Input Specifications

The following table applies to all inputs, 1001 - 1016, on the I/O card.

Table 4-5. I/O Card Input Specifications

Operational voltage range	0 to 30 VDC
“OFF” state voltage range	0 to 3 VDC
“ON” state voltage range	10 to 30 VDC
Typical threshold voltage	$V_{in} = 8$ VDC
Operational current range	0 to 12.5 mA
“OFF” state current range	0 to 1.25 mA
“ON” state current range	4.2 to 12.5 mA
Typical threshold current	3.3 mA
Impedance (V_{in}/I_{in})	2.4 K Ω minimum

NOTE: The input current specifications are provided for reference. Voltage sources are typically used to drive the inputs.

In the following figure, Example 1 shows inputs 1001 to 1003 with a negative common, Example 2 shows inputs 1004 to 1006 with a positive common, and Example 3 shows inputs 1007 and 1008 with independent power supplies (no common).

NOTE: These are examples. Either method can be used on any channel.

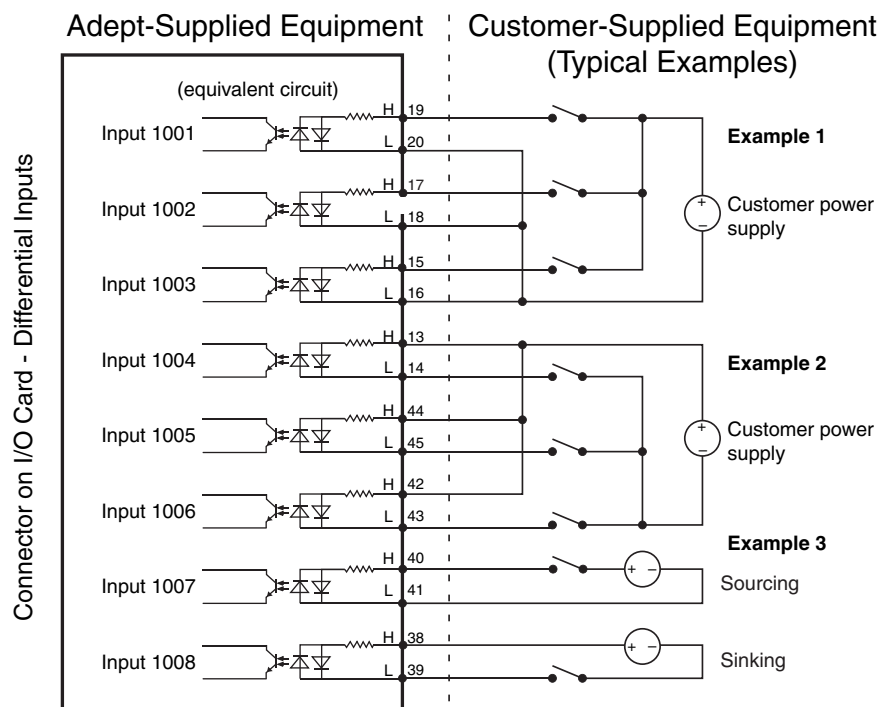


Figure 4-3. Differential Digital Inputs, 1001 through 1008

Typical Input Wiring Example

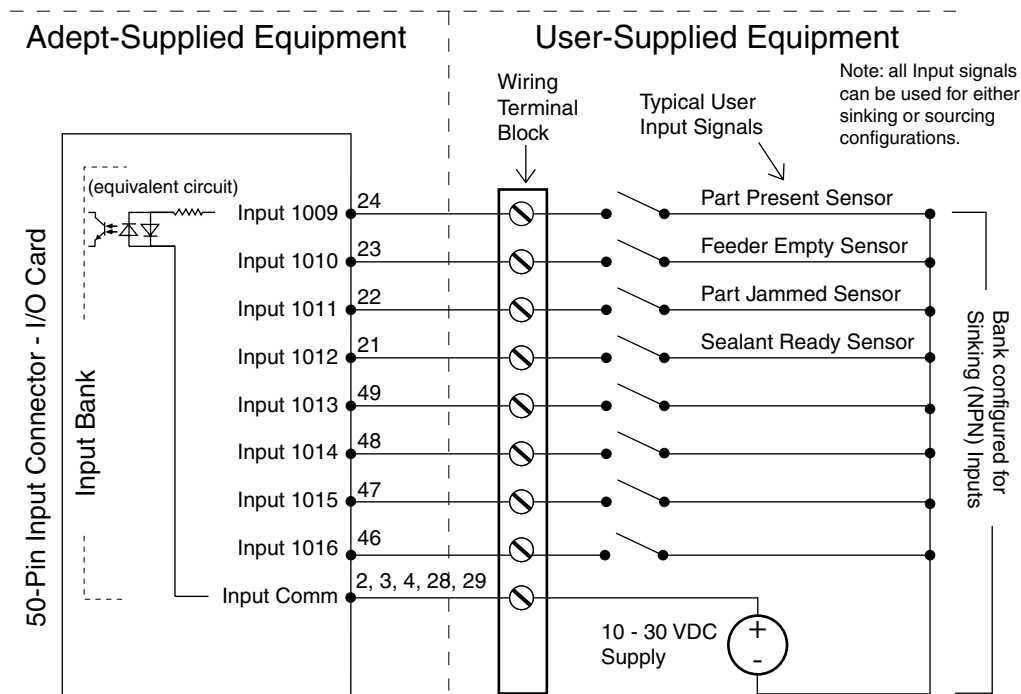


Figure 4-4. Typical User Wiring for Sinking Input Signals 1009 - 1016

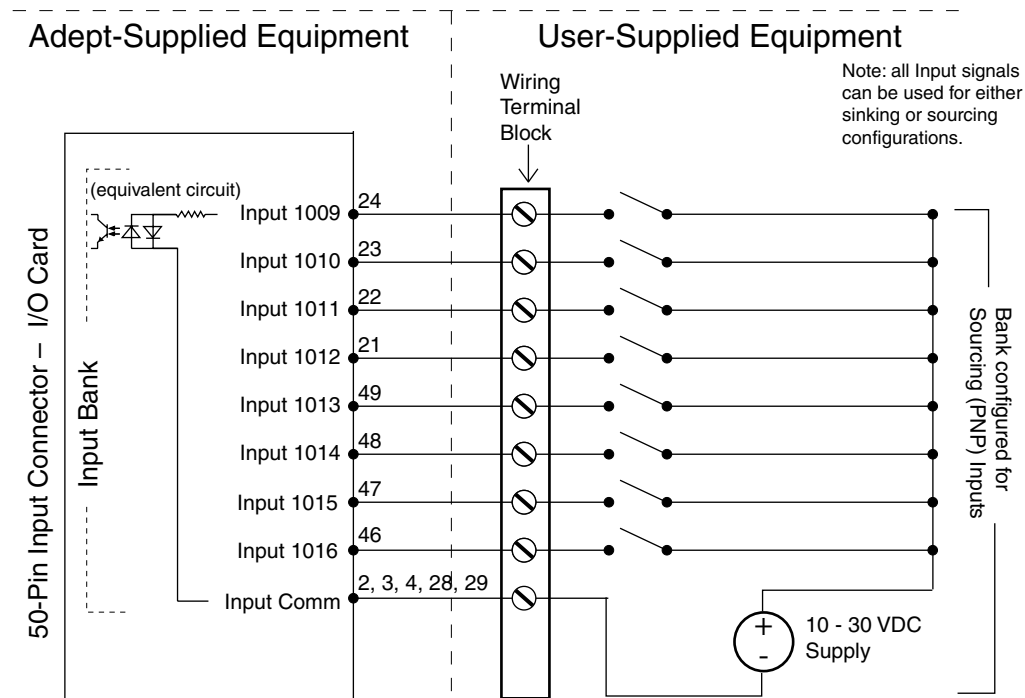


Figure 4-5. Typical User Wiring for Sourcing Input Signals 1009 - 1016

Output Signals

The sixteen digital outputs (1 - 16) share a common, low side (sinking) driver IC. The driver is designed to supply any kind of load with one side connected to 10 to 30 VDC. The driver does not include short-circuit protection and the user must take care to prevent shorts. An overload may damage the driver circuit. Internal “fly-wheel” diodes are included for driving inductive loads. The VDD power pin must be connected when driving inductive loads.

The outputs are accessed through a direct connection to the 50-pin connector, or through the optional terminal block.

Output Specifications

Table 4-6. I/O Card Output Specifications

Parameter	Value
Power supply voltage range	10 to 30 VDC
Operational current range, per channel	$I_{out} \leq 62.5 \text{ mA}$, all channels active $I_{out} \leq 500 \text{ mA}$, one channel active

Typical Output Wiring Example

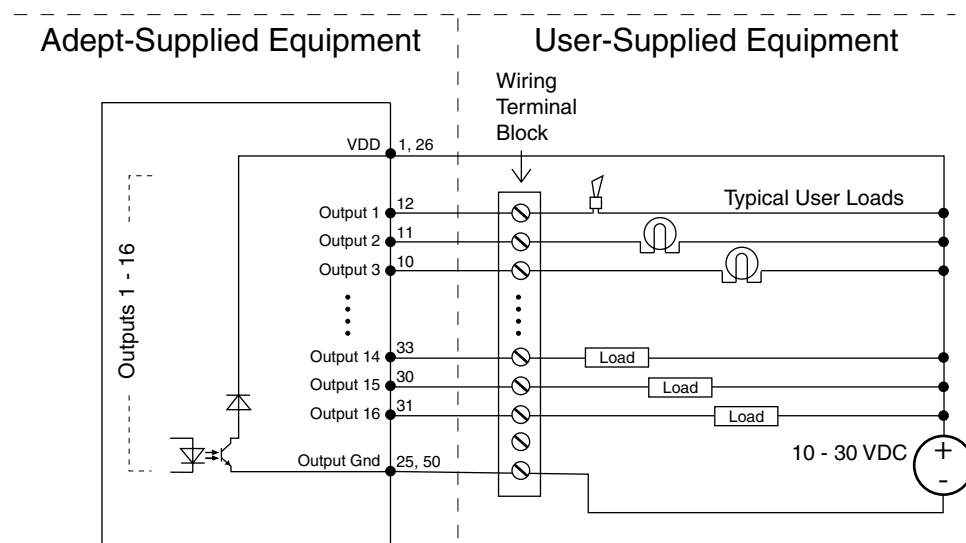


Figure 4-6. Typical User Wiring for Output Signals

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